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Abstract. Mountain activities or outdoor activities located in the mountains is one form of ecotourism that is popular for many people. One type of mountaineering that is often done is mountain climbing (mountain hiking) because of the many mountains scattered almost throughout the Indonesian archipelago. For beginner hikers it is advisable to hiking in groups, as well as adjusting to the experience and ability of climbers in order to anticipate the subjective risks. In this study, the Design of Decision Supporting Approval Approved Mountain Best For Hiking 'Go-Hiking' using Web Based Weighted Product method and for Android using TOPSIS method. Weighted Product (WP) and TOPSIS is example of the methods used to solve MADM problems. Multi Attribute Decision Making (MADM) is a method used to find the most optimal alternative of a number of optimal alternatives with certain criteria. The end result of the use of the Weighted Product and TOPSIS method is to display the best recommendations that can only be made as a consideration in the mountain selection.

Keywords: TOPSIS, Weight Product, Mountain, Hiking

1. Introduction

Mountaineering or outdoor activities where located in the mountains is one form of ecotourism that is popular for many people. One type of mountaineering that is often done is mountain climbing (hiking). It because of the many mountains scattered almost throughout the Indonesian archipelago [1]. According to Gunung Gede Pangrango National Park (TNGGP) statistical data, the number of visitors in 2013 is 139,767 people, and in 2016 the number is 162,184 people (Ministry of Forestry, Statistics 2016: 88), the number of mountaineers is increasing, this hiking activity has become so popular [1].

For novice climbers, the proper selection of mounts to climb should adjust to the experience and ability of the climbers themselves in order to anticipate the subjective risks. Climbers need to prepare physically, mentally and also hiking education, such as understanding the difficulty of the terrain, safety, and distance. Generally, mountain climbing can be done by solo, but it is not recommended for novice climbers because of the difficulty level and high teamwork needs (Lee, 2006) [2]. Therefore, it is recommended to climb in groups. Hiking also allows climbers to share accommodation, logistics and can expand the network mountain climber friends network. Climbers who are connected in

mountain climbing organizations will find climbing friends easier than climber who isn't connected to the organization

The problem that occurs is adjusting the climbers experience to determine the right mountains, and it is better to climb in groups. So, we need an information system that can help the climbers to determine the best mountain based on experience, altitude, mileage, travel time, & security, and a system that allows climbers to find climbing friends.

In this study, TOPSIS and WP Product methodology will be compared to find which best methodology that to determine the best mountain recommendation system that can be climbed for beginners in West Java.Based on APGI (Indonesian Mountain Guides Association) recommendation; Experience, Sports and Disease History are used as the criteria.

In the comparison analysis, the author will compare the results of manual and system calculations. The results of the system will be compared with the results from APGI and the percentage of success will be calculated

2. The Present Methodology

2.1. TOPSIS

In 1980, Yoon and Hwang introduce TOPSIS methode for solving Mutliple Criteria Decision Making (MCDM). Euclidian distance between alternative and ideal solutioan are used to choose the best alternative solution. The shortest distance used for Positive Ideal Solution (PIS) and the farthest distance used for Negative Ideal Solution (NIS) [3][4].

In 2014, Srikrishna et. all are implementing TOPSIS methodto determine which new car should buy. Their used 4 criteria such as style, life span, full economy, and cost [3].Then, in 2016 Assamaoi et.all also used TOPSIS methodto decided which country will be choice to expend market for one product. 5 countries in Africa are used as an alternative solution, and the data represent during 2000 until 2013[5].There are seven steps in TOPSIS method[3][5]:

Step 1: Construct the Decision Matrix (DM).

$$DM = \begin{array}{c} \\ L_1 \\ L_2 \\ \vdots \\ L_m \end{array} \begin{array}{c} \begin{array}{cccc} C_1 & C_2 & \cdots & C_n \end{array} \\ \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \end{array} \quad (1)$$

Where C refer to criteria, so index (i=1…n) refer to number of criteria. Four criteria used in this paper such as altitude, distance, secure, and time. L refers to alternative solution, so index (j=1…m) refer to number of alternative solution.

Step 2: Find the value of Normalised Decision Matrix. The Normalized Decision Matrix (NDM) which represents the relative performance of the generated design alternatives.

$$\mathrm{NDM} = R_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x^2_{ij}}} \text{---------- (2)}$$

Step 3: Calculate the weighted decision matrix. The weighting decision matrix is simply calculated by multiply each element of each column of the normalized decision matrix by the random weights.

$$V = V_{ij} = W_j \times R_{ij} \text{--------- (3)}$$

Step 4: Determine Positive and Negative Ideal Solution value. In order to define positive ideal (A+) and the negative ideal (A-), the solutions are using the weighted decision matrix via equations (4) and (5) below.

$$PIS = A^{+} = \{V_1^{+}, V_2^{+} \ldots, V_n^{+}\} \text{ where : } V_j^{+} = \{(\text{maxi}(V_{ij}) \text{ if } j \in J); (\text{mini } V_{ij} \text{ if } j \in J^1)\} \quad (4)$$

$$NIS = A^{-} = \{V_1^{-}, V_2^{-} \ldots, V_n^{-}\} \text{ where : } V_j^{-} = \{(\text{mini}(V_{ij}) \text{ if } j \in J); (\text{maxi } V_{ij} \text{ if } j \in J^1)\} \quad (5)$$

Where, element Jrefers to the beneficial attributes and J' refersto non-beneficial attributes

Step 5: Calculate the separation distance of each competitive alternative from the ideal and non-idealsolution.

$$S^{+} = \sqrt{\sum_{j=1}^{n} (V_j^{+} - V_{ij})^2} \text{i} = 1 \ldots\ldots, \text{m} \quad (6)$$

$$S^{-} = \sqrt{\sum_{j=1}^{n} (V_j^{-} - V_{ij})^2} \text{i} = 1 \ldots\ldots, \text{m} \quad (7)$$

Where, i = criterion index, j = alternative index.

Step 6: Measure the relative closeness of each location to the ideal solution. For each competitive alternative the relative closeness of the potential location with respect to the ideal solution is computed.

$$Ci = S_i^{-} / (S_i^{+} + S_i^{-}), \; 0 \leq Ci \leq 1 \quad (8)$$

Step 7: this is the last step. ordering all candidate alternative solution using value of C. First rank for the higher value, which has relative closeness solution.

2.2 Weight Product

Weighted Product (WP) method [6] is another scoring method where the weighted product of the criterion is used to select the best alternative. There were several researches in WP method for decision making system such as in food choice for person with special healthy condition [6], and decision system for determine people who got recipients from government (PNPM) [7]
They are five steps as a procedure to execute WP [6]:

- Step 1 : made the decision matrix using all alternative solution and their criteria.
- Step 2 : calculate the normalized decision matrix for each criteria as a value for criteria of benefit

$$W_j = \frac{wj}{\sum w_j} \quad (9)$$

- Step 3: Construct weighted normalized decision matrix
- Step 4: Calculate the score of each alternative

$$S_i = \prod_{j=1}^{n} X_{ij} W_j \quad (10)$$

- Step 5: Select the best alternative

3. Analysis and Results

As for how the recommendation system works on Go-Hiking applications.

3.1 Calculate with WP Method

This research will implement Weighted Product algorithm in recommended mountain app for hiking. The mount criteria, and mount alternative can be seen on Table 1.

In Table 1, there are 4 criteria and 6 alternatives of mountain. Such as Papandayan, Gede, Cikuray, Pangrango, Kendang, and Ciremai. And 4 criteria, altitude, distance, time, secure.

Table 1. Criteria, Atribute and alternative

Alternative	Altitude	Distance	Time	Secure
A1 (Mount Papandayan)	2622	14000	720	100
A2 (Mount Cikuray)	2821	8300	480	80
A3 (Mount Pangrango)	3019	10000	480	100
A4 (Mount Ciremai)	3078	15300	600	80
A5 (Mount Kendang)	2608	8000	420	10
A6 (Mount Gede)	2958	8400	360	100

Weighted Product (WP) method is using process of normalization with process is value of each attribute multiply by weight attribute. The weight for every category is Altitude = 20, Distance = 30, Time = 10, and Secure = 40.

- Construct weighted normalized decision matrix

$$W = \frac{20}{20+30+10+4} = 0{,}2$$
$$W = \frac{30}{20+30+10+40} = 0{,}3$$
$$W = \frac{10}{20+30+10+40} = 0{,}1$$
$$W = \frac{40}{20+30+10+4} = 0{,}4$$

- Calculate the score of each alternative

$S1 = (2622^{-0,2})\ (1400^{-0.3})\ (720^{-0.1})\ \ (100^{0.4}) = 0.038610178$
$S2 = (2821^{-0,2})\ (8300^{-0.3})\ (480^{-0.1})\ \ (80^{0.4}) = 0.042394335$
$S3 = (3019^{-0,2})\ (10000^{-0.3})\ (480^{-0.1})\ \ (100^{0.4}) = 0.043241749$
$S4 = (3078^{-0,2})\ (10000^{-0.3})\ (480^{-0.1})\ \ (100^{0.4}) = 0.033912493$
$S5 = (2608^{-0,2})\ (8000^{-0.3})\ (420^{-0.1})\ \ (10^{0.4}) = 0.019208195$
$S6 = (2950^{-0,2})\ (8400^{-0.3})\ (360^{-0.1})\ \ (100^{0.4}) = 3{,}604529404$

- Select best alternative

Using equation 10, the ranking for alternative solution are display in table 10

Table 2. result best alternative using WP

Ranking	Alternative	Result
1	Mount Gede	0.20977907
2	Mount Pangrango	0.19265447
3	Mount Cikuray	0.18887899
4	Mount Papandayan	0.17201948
5	Mount Ciremai	0.15108994
6	Mount Kendang	0.08557805

3.2 Calculate with TOPSIS Method

This research will implement TOPSIS algorithm in recommended mountain app for hiking. The mount criteria, and mount alternative can be seen on figure 1.

Fig 1. Decision Matrix

Name	Alternative	C1	C2	C3	C4
Mount Lembu	A1	792	2910	120	80
Mount Batu Jonggol	A2	875	3000	120	80
Mount Bongkok	A3	923	3100	120	80
Mount Tampomas	A4	1684	3700	300	10
Mount Sangga Buana	A5	1720	4000	240	50

Weight criteria are the same with WP.

- Convert analysis data in fuzzy form

Fig 2. Result fuzzy form

Alternative	C1	C2	C3	C4
A1	7,92	29,1	1,2	0,8
A2	8,75	30	1,2	0,8
A3	9,23	31	1,2	0,8
A4	16,84	37	3	0,1
A5	17,2	40	2,4	0,1

- Normalized matrix

C1 = (√7,92^2) + (√8,75^2) + (√9,23^2) + (√16,84^2) + (√17,2^2)
= 28,35326084
C2 = (√29,1^2) + (√30^2) + (√31^2) + (√37^2) + (√40^2)
= 75,3446083
C3 = (√1,2^2) + (√1,2^2) + (√1,2^2) + (√3^2) + (√2,4^2)
= 4,368065934
C4 = (√0,8^2) + (√0,8^2) + (√0,8^2) + (√0,1^2) + (√0,5^2)
= 1,476482306

- Normalized R

Fig 3. Result of Normalization

Alternative	C1	C2	C3	C4
Normalization	R1	R2	R3	R4
A1	0,27933295	0,38622538	0,274721128	0,541828369
A2	0,308606479	0,398170495	0,274721128	0,541828369
A3	0,325535749	0,411442845	0,274721128	0,541828369
A4	0,593935213	0,491076944	0,68680282	0,067728546
A5	0,606632165	0,530893994	0,549442256	0,338642731

- Weight (W)

C1 = 20/100 = 0,2, C2 = 40/100 = 0,4, C3 = 30/100 = 0,3, C4 = 10/100 = 0,1

- Weight Normalization

Fig 4. Result of Weight Normalization

Alternative	C1	C2	C3	C4
Weigth Criteria	Y1	Y2	Y3	Y4
A1	0,05586659	0,154490152	0,082416338	0,054182837
A2	0,061721296	0,159268198	0,082416338	0,054182837
A3	0,06510715	0,164577138	0,082416338	0,054182837
A4	0,118787043	0,196430778	0,206040846	0,006772855
A5	0,121326433	0,212357597	0,164832677	0,033864273

- The distance between the values of each alternative with the positive ideal solution matrix & negative ideal solution matrix.

Fig 5. Result of Distance

Alternative Distance	Positive(+)	Negative(-)	D+ + D-
A1	0	0,158632776	0,158632776
A2	0,007556937	0,154602658	0,162159596
A3	0,013679738	0,151572773	0,16525251
A4	0,152475325	0,016127991	0,168603316
A5	0,121815143	0,049315902	0,171131045

- Select best alternative
  Using equation 8, the ranking for alternative solution are display in table 3

Table 3. Final Result

Ranking	Alternative	Result
1	Gunung Lembu	1
2	Gunung Batu Jonggol	0,953398149
3	Gunung Bongkok	0,917219183
4	Gunung Tampomas	0,095656428
5	Gunung Sangga Buana	0,288176244

4. Testing

Testing is done by comparing the results of excel calculations and the results of calculations on the system. Following is the calculation table:

Tabel 4. Result Compare WP and TOPSIS

No	Category	WP	TOPSIS
1	Beginner	100 %	100%
2	Medium	100%	96,47 %
3	Expert	100%	100%
	Total	100%	98,82 %

Based on the results, of the average percentage of Hamming Distance between the results of school ranking with three methods as in Table 4, WP method obtains the best results because it has a large percentage of accuracy so that it will minimize errors and these results have been tested 50 times.

5. Conclusion

Accuracy testing is used to determine the level of accuracy between two calculations, they are using Excel and System. There are three outputs, namely Beginner, Medium, and Expert. For the criteria tested, namely, height, distance, time and security.

The results obtained from the Calculation of Accuracy values of both methods against the results of mountain ranking, obtained WP method to be the best order with 100%. For the Accuracy Calculation value, the TOPSIS method becomes the second best method with a percentage of 98.82%.

Based on the results of the above analysis prove that the mountain selection system using the WP method has a good system performance compared to using the TOPSIS method. This recommendation feature is expected to help beginners to determine which mountain can be climbed according to the criteria chosen. It is expected that in the future this application can be developed by adding several features

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